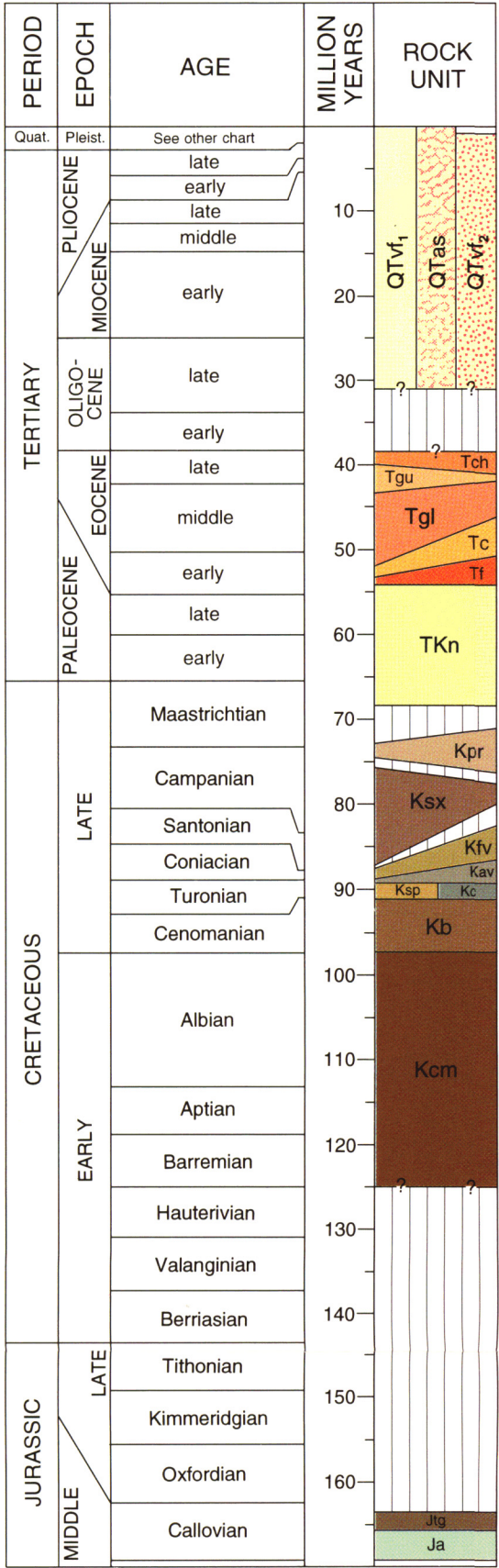
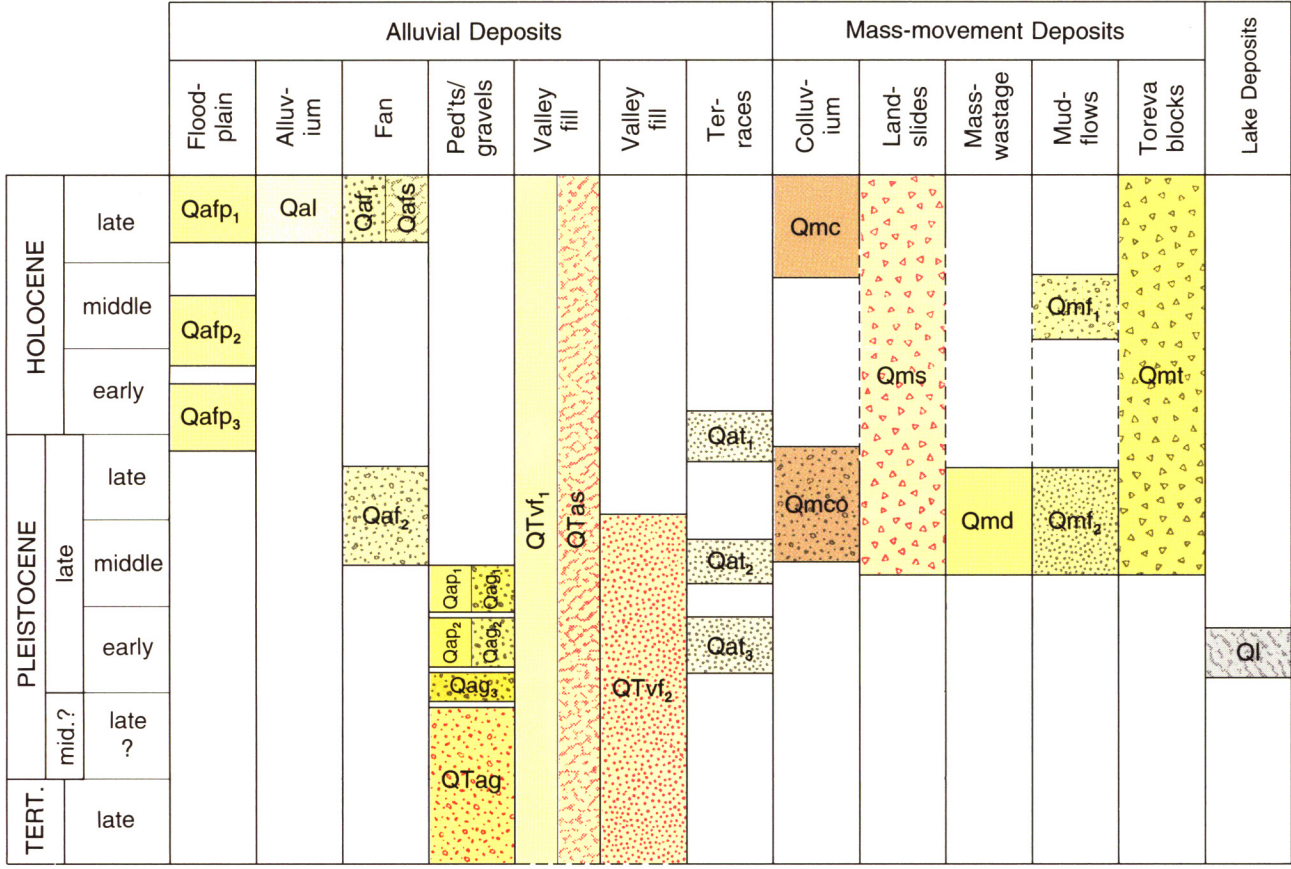




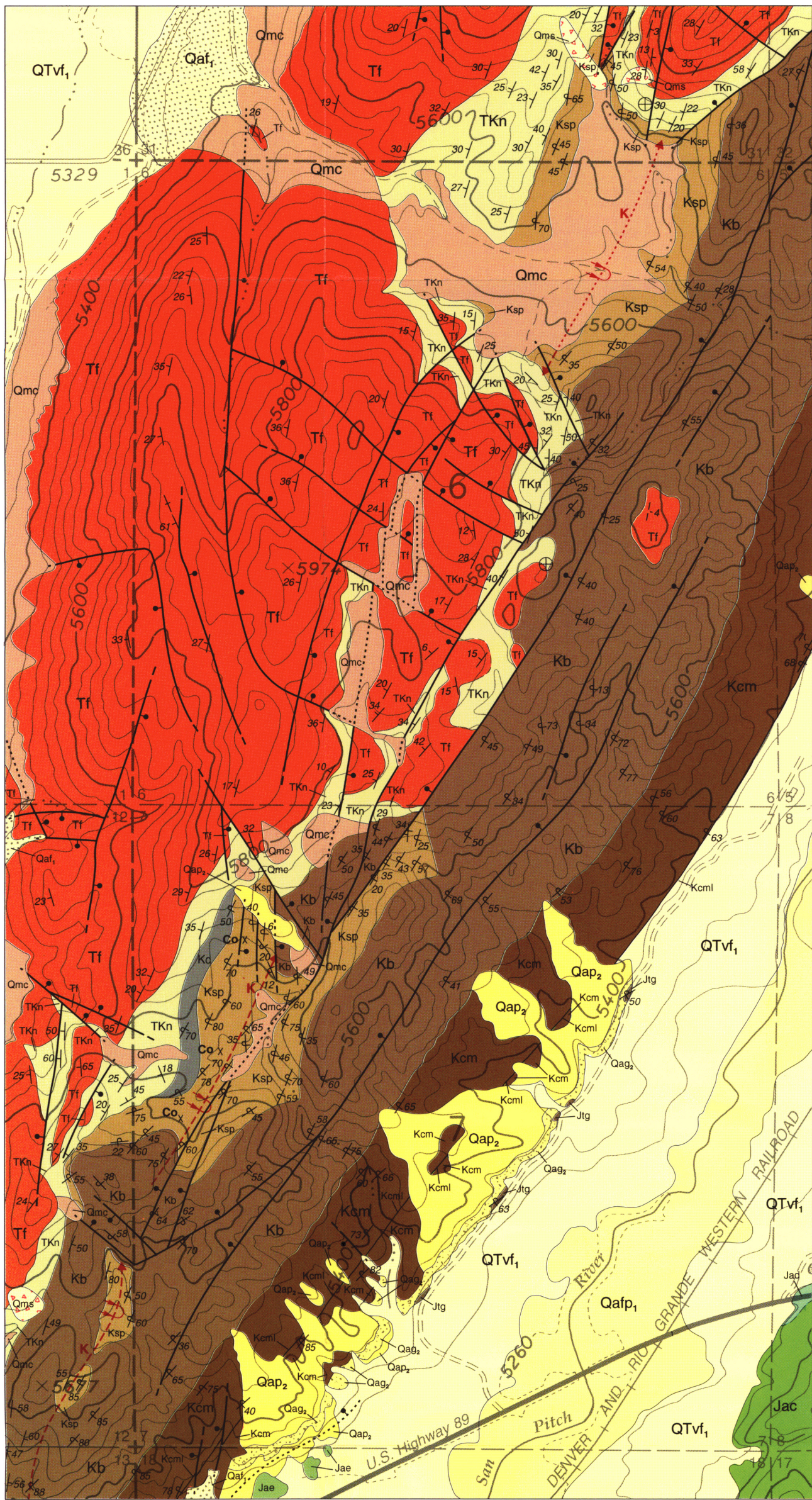
CORRELATION OF BEDROCK UNITS



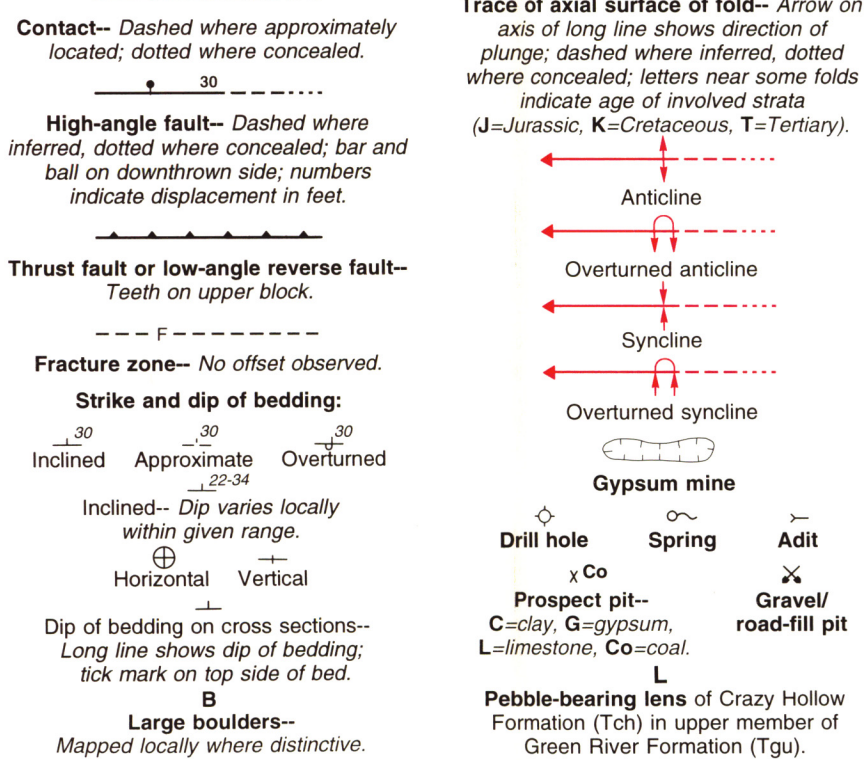
CORRELATION OF QUATERNARY UNITS



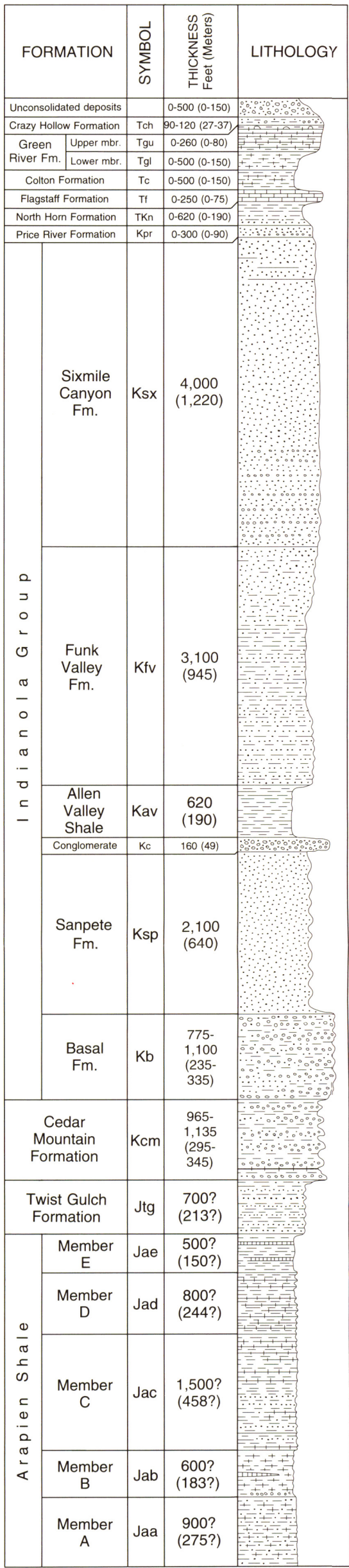
GEOLOGY OF SOUTHEASTERNMOST GUNNISON PLATEAU  
1:12,000 SCALE ENLARGEMENT FROM PLATE 1



MAP SYMBOLS



LITHOLOGIC COLUMN



Query (?) indicates estimated subsurface thickness.

DESCRIPTION OF MAP UNITS

**QUATERNARY DEPOSITS**  
Artificial fill (modern)— Earth-fill dams.

**ALLUVIAL DEPOSITS**  
Floodplain deposits (late Holocene)— Alluvial material; brown and brownish-gray, poorly sorted, and close in both area and level to the principal streams; coarse fraction mostly in point bars; thickness probably less than 30 feet (9 m).

Older floodplain deposits (early-middle Holocene)— Like the modern floodplain deposits, but grayer, found as remnants 15 to 20 feet (4.5-6 m) above Qafp<sub>1</sub>; thickness is unknown.

Oldest floodplain deposits (Pleistocene-Holocene)— Like Qafp<sub>1</sub>, but lying 30 to 40 feet (9-12 m) above Qafp<sub>1</sub>; thickness is unknown.

Alluvium (late Holocene)— Fluvial material; dark-brown to gray clay, silt, sand, granules, pebbles, and sparse cobbles; thin to thick-bedded, locally massive and cross-bedded; along intermittent streams and at upper ends of fans; forms broad, even surfaces of low relief; thickness is varied, commonly less than 50 feet (15 m).

Alluvial-fan deposits (late Holocene)— Light-brown to brown, locally gray, unconsolidated to semi-consolidated, moderately well-sorted silt, sand, granules, pebbles, or cobbles at the mouths of canyons; commonly lobate; thickness is uncertain; large fans to 70 feet (21 m), small fans less than 30 feet (9 m); grade to alluvium upstream and valley fill downstream. Mapped as Qaf<sub>1</sub> where it includes salt marsh deposits.

Older alluvial-fan deposits (late Pleistocene)— Like the younger alluvial-fan materials, but so deeply dissected by modern drainages that the surface is no longer building; however, the surfaces do grade to modern valley-fill surfaces; to 30 feet (9 m) thick.

Alluvial-terrace deposits (Holocene and Pleistocene)— Gray and brownish-gray alluvial deposits mixed with North Horn and Flagstaff colluvium; the upper surface stands 160 to 170 feet (49-52 m) above Sixmile Creek; thickness unknown.

Older alluvial-terrace deposits (middle late Pleistocene)— Alluvial deposits of boulders, cobbles, and local sand lenses; lower edge of surface is more than 40 feet (12 m) above Sixmile Creek, and the terraces parallel the stream gradient; underlies Qmf<sub>1</sub> and Qaf<sub>2</sub>; maximum exposure is 30 feet (9 m) thick; total thickness is unknown.

Oldest alluvial-terrace deposits (early late Pleistocene)— Like the other terrace deposits, but the surface stands 40 to 150 feet (12-46 m), distally to proximally, above Sixmile Creek; thickness is unknown.

Pediment-mantle deposits (middle late Pleistocene)— Alluvial deposits spread on stream-cut rock surfaces; brown, gray, or locally reddish brown; massive to crudely bedded; unconsolidated mixture of silt, sand, granules, pebbles, cobbles, and boulders; surfaces are even and slope from uplands (proximal) toward the streams (distal); deposits are 30 to 60 feet (9-18 m) thick; surfaces range from about 20 to 50 feet (6-15 m), distally to proximally, above Twelvemile Creek.

Older pediment-mantle deposits (early late Pleistocene)— Deposits like Qap<sub>1</sub>, but deformed by tilting (35-45 degrees) or by elevation above the younger surfaces by as much as 70 feet (21 m); deposits are about 40 feet (12 m) thick; above the water table the deposits are well cemented in some layers, and are yellowed by limonite.

Stream gravel (middle late Pleistocene)— Limestone and chert cobbles and pebbles from the Flagstaff Limestone; found in streaks and patches within and bordering the younger pediments (Qap<sub>1</sub>); 10 to 20 feet (3-6 m) thick and at the same elevations as Qap<sub>1</sub>.

Older stream gravel (early late Pleistocene)— Moderately sorted cobble and pebble gravels with little sand, mostly limestone and chert of the Flagstaff Limestone; less than 15 feet (5 m) thick west of river and averaging 30 to 40 feet (9-12 m) east of river.

Alluvial (?) gravel (middle to early late Pleistocene)— Gray and brownish gray, mostly pebble gravels with some fines; poorly bedded with numerous poorly sorted layers; mostly limestone and chert from the Flagstaff; 20 feet (6 m) thick at maximum.

**MASS-MOVEMENT DEPOSITS**  
Colluvium (Holocene)— Gravity and slope wash sediments; gray to brown; unconsolidated to semi-consolidated; deposits mantle lower valley walls and accumulate at the base of some steep cliffs; grades to alluvium, valley fill, or fans as slopes lessen; thickness ranges from 0 to 50 feet (0-15 m).

Older colluvium (late Pleistocene)— Gray, but otherwise like Qmc; occurs as sharply dissected aprons of weakly consolidated material; Flagstaff Limestone debris; larger in area than Qmc and 0 to 100 feet (0-30 m) thick.

Landslide deposits (Holocene and late Pleistocene)— Gravity deposits; brown to dark-brown and gray fragments of diverse sizes and shapes; hummocky topography with concentric ridges; includes small toreva blocks; thickness ranges from 0 to perhaps 60 feet (18 m).

Debris-flow deposits (late Pleistocene)— Brown to gray masses of broken rock of diverse sizes and shapes; non-stratified; includes small earthflows and rock falls; hummocky and irregular surface; thickness ranges widely, but does not exceed about 300 feet (90 m). Mapped in three subdivisions, according to source: Qmd (Tg), Qmd (Tc), and Qmd (TKn).

Mudflow deposits (middle Holocene)— Gray and brownish-gray, very poorly sorted, angular debris moved by mudflow; fine material is from the North Horn and most of the coarse material is Flagstaff Limestone; hummocky surface; thicknesses range up to 200 to 300 feet (60-90 m).

Older mudflow deposits (late Pleistocene)— Similar to Qmf<sub>1</sub> in texture and composition but much longer; dissected by both Funk and Sixmile Creeks; thickness ranges from 0 to 150 feet (45 m).

Toreva blocks (Holocene-late Pleistocene)— Masses of rock that slumped with little internal disturbance; small toreva blocks are lumped with colluvium and are probably Holocene in age; large blocks are probably older; thickness is unknown.

**LACUSTRINE DEPOSITS**  
Lake deposits (early late Pleistocene)— Marl, clay, thin sands, and some pebble bands; fossiliferous; little cementation; base not exposed, but apparently lies on Arapien Shale; overlain by Qaf<sub>2</sub>; 12.8 feet (3.9 m) exposed.

**QUATERNARY AND TERTIARY DEPOSITS**  
Older alluvial (?) gravel (middle Pleistocene)— Material and structure like Qag<sub>1</sub>, but has been turned on edge, in angular unconformity beneath Qag<sub>1</sub>; maximum thickness exposed is less than 50 feet (15 m). Regionally this unit is older.

Valley-fill deposits (Holocene at surface, Tertiary at depth)— Gray and brownish-gray, poorly sorted, unconsolidated alluvial and colluvial debris in large valleys; grades to fans, colluvial and alluvial deposits at valley margins; probably 0 to 700 feet (0-215 m) thick.

Salt marsh deposits on valley fill (Holocene at surface, Tertiary at depth)— Same material as QTV<sub>1</sub>, and has a concordant surface, but is water-saturated and contains local pond sediments; thickness like QTV<sub>1</sub>; probably 0 to 700 feet (0-215 m) thick.

Older valley-fill deposits (late Pleistocene at surface, Tertiary at depth)— Material and origin like those of QTV<sub>1</sub>, but surface is 15 to 30 feet (4.5-9 m) higher than the younger valley fill and associated deposits; probably 0 to 700 feet (0-215 m) thick.

**TERTIARY ROCKS**  
Crazy Hollow Formation (late Eocene)— Red to reddish-brown mudstone; red, light-yellow-brown, and locally white sandstone, shaly siltstone, and some conglomerate; sandstone and conglomerate that are not red are marked by grains and pebbles of black chert giving a 'salt and pepper' look; locally contains lenses of dense, micritic, light-gray, pink, or dark-gray to black limestone; mostly fluvial, but locally pond or lacustrine deposits; thickness is 0 to 120 feet (37 m).

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Green River Formation (Eocene)

**Tgu**—Upper member— White to yellowish-gray, thin-bedded, platy, micritic, well-cemented limy mudstone, and ostracodal and oolitic limestone interbedded with thin shale layers; yellowish-orange near the top, with silicified stromatolite beds and some tufts; interfingers with Crazy Hollow Formation. Maximum thickness in quadrangle is 180 to 260 feet (55-80 m).

**Tgl**—Lower member— Light-gray and greenish-gray, shaly mudstone with thin layers of limestone, some siltstone, and minor sandstone; 0 to 300 feet (0-90 m) thick in central area and to 500 feet (150 m) thick in the southeast corner; pinches out over Jurassic rocks.

**Tc**—Colton Formation (early Eocene)— Claystone and mudstone variegated in shades of reddish brown, light gray, violet, or light greenish gray; locally includes beds of yellowish-gray to yellowish-brown siltstone and sandstone; sparse, thin beds of platy, light-gray, micritic, lacustrine limestone; pinches out over the disturbed belt of Mesozoic rocks, but is 280 feet (85 m) thick in the central area and about 500 feet (150 m) thick in the southeast.

**Tf**—Flagstaff Limestone (Eocene)— Light-gray to yellowish-gray limestone; pinkish or grayish orange near base where unfossiliferous; Crataceous beds; micritic beds are slabby limestone; finely saccharoidal, massive beds are commonly dolomitic or dolomite; deposits in northwestern part of quadrangle are fractured, high-calcium micrites; thin to thick-bedded, locally massive; contains oncolites locally near the base; contains subordinate, interbedded, dark-gray, gray, and greenish-gray shale; forms resistant ledges and prominent hogbacks; ranges widely in thickness from 0 to 400 feet (0-122 m); average maximum thickness is about 250 feet (75 m).

TERTIARY AND CRETACEOUS ROCKS

**TKn**—North Horn Formation (Maastrichtian to early Eocene)— Claystone, sandstone, conglomeratic sandstone, conglomerate, and sparse limestone; units alternate irregularly; mudstones are thick-bedded to massive; sandstones range from thin to thick bedded and many are cross-bedded; fine to medium grained; limestone beds are thin, dense, and locally arenaceous; the formation slumps, slides, and flows easily; ranges in thickness from pinchout to 620 feet (190 m).

CRETACEOUS ROCKS

**Kpr**—Price River Formation (Late Cretaceous)— Gray to light-gray or yellowish-brown conglomerate, conglomeratic sandstone, and sandstone, with minor shale; thin to thick bedded; locally massive; commonly well cemented; coarse conglomerates contain well-rounded clasts of light-brown and purple quartzite, and red-and-white striped quartzite, light-gray quartz, light-gray chert, and sparse dark-bluish-gray limestone; sandstones are fine to coarse grained; form steep slopes and low cliffs; ranges in thickness from 0 to 300 feet (90 m).

Indianola Group

**Ksx**—Sixmile Canyon Formation (Late Cretaceous)— Three intergrading parts are distinguished: a lower interval (slightly more than half the formation) of sandstone with some conglomerate and conglomeratic sandstone; a middle interval (slightly less than one-third) of sandstone with some arenaceous shale, and coal; and an upper interval (slightly less than one-fourth) of coarser sandstone with minor conglomerate and a few coal beds; the formation is perhaps 4,000 feet (1,220 m) thick.

**Kfv**—Funk Valley Formation (Late Cretaceous)— Three intergrading parts are distinguished: 900 to 1,000 feet (275-304 m) of thick beds of sandstone interbedded with shale; 1,300 feet (395 m) of an easily weathered, fine grained, muddy sandstone with 550 feet (165 m) of mudstone near the middle; and an upper sandstone unit like the lower one, but 800 to 900 (245-275 m) thick.

**Kav**—Allen Valley Shale (early Late Cretaceous)— Gray, fossiliferous, marine shale with thin layers of bentonitic mudstone, siltstone, and limy siltstone; thickness is 620 feet (190 m).

**Kc**—Conglomerate beds (early Late Cretaceous)— A massive, well-cemented, gray conglomerate present only locally on top of the Sanpete Formation west of the San Pitch River; gray in outcrop with colored Precambrian quartzite clasts; outcrop is only about 1,500 feet (455 m) long with an exposed thickness of 160 feet (49 m).

**Ksp**—Sanpete Formation (early Late Cretaceous)— Grayish-orange weathering, marginal marine sandstone with shale interbeds, some about 100 feet thick; sand has a range of grain sizes and sorting is moderate to good; rock is reasonably well cemented, and limonitic, particularly west of the San Pitch River; thickness is about 2,100 feet (640 m).

**Kb**—Basal formation of Indianola Group, new unit (early Late Cretaceous)— Reddish-brown and gray, thick-bedded to massive, well-cemented conglomerate with interbeds of sandstone and some mudstone; granules, pebbles, and well-rounded cobbles and boulders 3 to 6 feet (1-2 m) in diameter of white, red, red-striped, purple, green, grayish-green, and light-brown quartzite, light-brown to light-gray chert, white quartz, and some bluish-gray limestone; thickness 775 to greater than 1,100 feet (235-335 m). Equals "Gunnison Formation" of Roche (1985), upper Pigeon Creek of Schwans (1989), and upper Cedar Mountain of Witkind and others (1986).

**Kcm**—Cedar Mountain Formation (Early Cretaceous)— Mudstone, variegated in shades of red-orange, yellowish-gray, gray, purple, and green; massive to thick bedded; a few lenses and thin layers of limy sandstone occur; limy mudstone beds with lime nodules and oncolites are a signature of the unit; a few pebbles and cobble conglomerate layers 10 to 30 feet (3-9 m) thick are present near the base and close to the top; exposed thickness is 965 to 1,135 feet (295-345 m). A conspicuous layer, 20 to 40 feet (6-12 m) thick, of white, weathering, pale-pink limestone (Kcm) lies near the base of the unit.

JURASSIC ROCKS

**Jtg**—Twist Gulch Formation (Middle Jurassic)— Reddish-brown shale and silty mudstone with some thin to thick beds of reddish-gray to light-gray, gritty sandstone that weathers light brown; feldspathic; unfossiliferous; about 3,000 feet (915 m) thick regionally and 1,667 feet (510 m) locally.

**Ja**—Arapien Shale (Middle Jurassic)— Mudstone, calcareous, commonly light-gray, with red, salt-bearing beds and lenses; in places entirely drab gray, elsewhere wholly reddish brown; thin to medium bedded; evenly bedded; locally amorphous; has intercalated thin, lenticular beds and seams of yellowish-gray to light-brown siltstone and sandstone; sparse limestone beds have few fossils; contains thick beds of rock salt (halite), gypsum, and minor evaporites; abundant selenite crystals; formation is complexly deformed, with much shearing; erodes to badland topography with little vegetation; thickness uncertain. Unit is divisible into five intergrading members.

**Jae**—Member E: Brick-red, silty shale; locally salt-bearing; bedding obscure where deformed; exposed thickness incomplete, about 500 feet (150 m) locally.

**Jad**—Member D: Alternate layers of bluish-gray and red, gypsiferous shale; locally blotchy because of lenticular beds and facies changes; about 800 feet (244 m) exposed locally.

**Jac**—Member C: Light-gray, calcareous shale and limy mudstone; all thin-bedded; contains a few thin and medium beds of dense, sandy, fossiliferous limestone, and local pods of gypsum; local thickness may be about 1,500 feet (458 m).

**Jab**—Member B: Bluish-gray and red, gypsiferous shale; blotchy and streaked like member D, but has more red mudstone with local pods of halite; minimum local thickness is 425 feet (130 m) but may reach 600 feet (183 m).

**Jaa**—Member A: Light-yellowish-gray shale and thin-bedded limestone; some red gypsiferous shale, and light-gray, argillaceous limestone with large local pods of gypsum concentrated near the top; local thickness indeterminate, but about 900 feet (275 m).

